Association for Information Systems
AIS Electronic Library (AISeL)

PACIS 2011 Proceedings

Pacific Asia Conference on Information Systems (PACIS)

9 July 2011

The Information Systems Design Science Research Body Of Knowledge – A Citation Analysis In Recent Top-Journal Publications

Christian Fischer
University of St. Gallen, christian.fischer@unisg.ch

ISBN: [978-1-86435-644-1]; Full paper

THE INFORMATION SYSTEMS DESIGN SCIENCE RESEARCH BODY OF KNOWLEDGE – A CITATION ANALYSIS IN RECENT IS TOP JOURNAL PUBLICATIONS

Christian Fischer, Institute of Information Management, University of St. Gallen, Switzerland, Visitor to the Australian National University, Canberra, Australia, christian.fischer@unisg.ch

Abstract

Information systems (IS) design science research (ISDSR) has received particular attention after the seminal MISQ article by Hevner et al. (2004). Since then, several articles on ISDSR have appeared in top IS journals. This paper examines the development of a common body of knowledge in ISDSR. To this end, a citation analysis in recently published ISDSR articles in top IS journals is conducted. According to Kuhn (1970), a common body of knowledge is important for each emerging scientific discipline. For the purposes of delineating ISDSR from other types of IS research, the author develops three criteria. Based upon these criteria, he identifies 50 ISDSR articles published in the journals of the basket of the six from 2007-2010. An analysis of the citations of these articles reveals that Hevner et al. (2004) is cited as a source in 70% of all articles. Moreover, six further specific publications are cited by more than 10% of all articles. The author argues that ISDSR is developing a common body of knowledge and does have a cumulative tradition.

Keywords: Information Systems Design Science Research, Literature Review, Citation Analysis, Maturity Assessment.

1 MOTIVATION

In contrast to behavioural science research, which aims to describe, explain, and/or predict phenomena, information systems design science research (ISDSR) aims to develop solutions for solving information systems (IS) problems relevant to stakeholders (March & Smith, 1995; Gregor, 2006; Baskerville et al., 2009). Although some important contributions to ISDSR date back to the early or mid 1990s (Nunamaker et al., 1991; Walls et al., 1992; March & Smith, 1995; see also the review by Arnott and Pervan), the popularity of ISDSR significantly increased after the seminal publication of Hevner et al. in 2004 (Hevner et al., 2004). This assumption is underpinned by several facts. In 2006 the first conference dedicated specifically to ISDSR was held ("First International Conference on Design Science Research in Information Systems and Technology", DESRIST 2006). Further to this, the international conference on information systems (ICIS) and many regional IS conferences (AMCIS, ECIS, PACIS) organise tracks on ISDSR. Important IS journals now state that they accept ISDSR publications, among them the Management Information Systems Quarterly, whose editorial board contains at least four out of eighteen senior editors who are renowned experts in ISDSR (Shirley Gregor, Alan Hevner, Juhani Iivari, Vijay Vaishnavi). Moreover, important IS journals published special issues dedicated to ISDSR (e.g.; EJIS, Vol. 17, Is. 5, 2008; MISQ, Vol. 32, Is. 4, 2008; JAIS, Vol. 10, Is. 9, 2009; for the journal abbreviations see footnote 2).

As indicated above, IS design science researchers had a number of opportunities for publishing their research. The author therefore argues that it is now time to take stock and review the development of the body of knowledge of this sub-discipline. In order to identify the present state of ISDSR, we aim to identify journal publications on ISDSR and analyse their common intellectual ground in a citation analysis. We formulate the following research questions:

RQ1: How many and what publications in recent issues of top IS journals document ISDSR?

RQ2: What is the common intellectual ground of these publications ("ISDSR body of knowledge")?

RQ3: What conclusion can be drawn with respect to the maturity of the field?

The theoretical basis of this analysis is based on Kuhn's (1970) assumptions on how progress takes place in scientific disciplines (see also de Mey, 1982). Kuhn argues that new (sub-)disciplines start with a chaotic formation phase, called pre-paradigmatic phase. The researchers' common foundation is called a 'paradigm'. At the pre-paradigmatic phase, researchers have no consensus on the fundamental aspects of their field. After researchers have agreed upon such a foundation, the discipline enters into a paradigmatic phase in which normal science is done. In normal science, the paradigm is rarely questioned: research is therefore efficient, but revolutionary outcomes are rare until the discipline gets into a crisis. It is at the crisis point when common foundation is questioned as being inadequate to the goals of the discipline. A phase of revolutionary science with radically new outcomes follows. When researchers agree again upon a common foundation, normal science begins again. Due to its young age, it is unlikely that ISDSR has already reached the phase of normal science. The citation analysis to be conducted will, however, allow one to determine how far ISDSR is from the stage of normal science.

The three research questions formulated are important for IS design science researchers, IS researchers in general and decision makers in the field. First, the identification of ISDSR publications in top IS journals is relevant to those who intend to publish ISDSR in future. It allows them to identify exemplary articles and to select an appropriate journal for submission. Moreover, it informs all interested IS researchers on the present state of development of ISDSR. Secondly, and as a direct consequence of the first point, the identification of a common body of knowledge is helpful for IS researchers who wish to familiarise themselves with ISDSR. The common body of knowledge of ISDSR also informs the design of educational programs on ISDSR, for instance PhD courses. Thirdly, on a meta-level, the analysis of the common body of knowledge allows for interpretations on the current state of ISDSR, based upon the Kuhnian model as described above. The result of such an analysis has strong practical implications for decision makers in the field. This is exemplified by the

publication of the of special edition issues on ISDSR in top journals. For instance, the lack of a common foundation would call for further harmonisation of attitudes towards ISDSR. In this case, a special issue focusing on synthesizing literature analyses could be helpful for a further development of the discipline. If, in contrast, a common foundation has already been formed, the entrance into the phase of normal science should be fostered. To this end, for instance, special issues on applied design science research could be helpful for furthering the discipline (like for instance the JAIS special issue on collaboration engineering, Vol. 10, Is. 9, 2009) in contrast to a special a special issue that focuses on the theoretical fundamentals of ISDSR (e.g.; Business and Information Systems Engineering, Vol. 2, Is. 5, 2010).

This paper is organised as follows: firstly relevant related work is described; second the research process is outlined; third criteria for delineating ISDSR from other types of research in IS are developed as appropriate criteria have not, as yet, been presented in former research. The penultimate section of the work presents the findings of the analysis; and in the final part, a conclusion is drawn.

2 SUBSECTION HEADING

In this section, related work is presented. The focus is on literature reviews and other contributions that aim to describe the IS body of knowledge.

Literature reviews on ISDSR select important literature on ISDSR and thereby provide an overview of the common body of knowledge, e.g. in journal and conference publications (Vaishnavi & Kuechler, 2004; Venable, 2006; Kuechler et al., 2007; Fischer et al., 2010) or books (Vaishnavi & Kuechler, 2007; Hevner & Chatterjee, 2010). Moreover, many recent conceptual papers on ISDSR and ISDT also give an overview over relevant literature at the beginning of their paper (e.g.; Goldkuhl, 2004; Hevner et al., 2004; Gregor, 2006; Gregor & Jones, 2007; Peffers et al., 2007; Kuechler & Vaishnavi, 2008; Baskerville & Pries-Heje, 2010; Offermann et al., 2010a; Aier & Fischer, 2011). However, all these literature reviews lack of a systematic approach: literature is not selected with respect to pre-defined criteria from a pre-defined set of papers; an ISDSR body of knowledge is moreover not developed systematically. To the best of the author's knowledge, only two systematic reviews on recent ISDSR literature exist (Indulska & Recker, 2010; Offermann et al., 2010b). Offermann et al. (2010b) however do not identify ISDSR contributions in recent issues of IS top-journals, but in publications of the DESRIST conferences.

Indulska and Recker (2010) analyse conference publications in order to identify ISDSR contributions. Their analysis encompasses papers from 2005-2007 published at the IS conferences ACIS, AMCIS, ECIS, ICIS, and PACIS.[1] Out of a total of 3,284 articles, they identify 3% (83 articles) as ISDSR. The authors also note that the number of publications increases from 2005 to 2007. Around 40% of ISDSR publications originate from within the USA, 34% from Europe, and 19% from Pacific/Asia. Among the 83 ISDSR papers identified, Indulska and Recker determined 57 papers as being ISDSR application papers rather than conceptual papers. Whilst Indulska and Recker perfectly describe their analysis sample, they unfortunately do not explain their strategy for discerning ISDSR from other types of IS research; this could have been a useful inspiration for the research method applied in this paper. This article differs from that by Indulska and Recker as more recent papers are analysed in this paper and as the focus of this paper is on journal articles rather than conference publications.

Besides the literature overviews on ISDSR discussed above, the only systematically ordered list of literature on ISDSR is provided by Vaishnavi and Kuechler (2004). They recommended literature for IS researchers interested in DSR. However, this list is an expert judgement rather than a systematically developed and justified research result.

[1] ACIS: Australian Conference on Information Systems, AMCIS: American Conference on Information Systems, ECIS: European Conference on Information Systems, ICIS: International Conference on Information Systems, PACIS: Pacific Asia Conference on Information Systems

3 RESEARCH PROCESS

A rigorous literature analysis should be traceable for the reader so that s/he can replicate its research process and verify its research findings (vom Brocke et al., 2009). The author therefore follows Toracco's (2005) recommendation who suggests: "[T]he author's strategy for selecting the literature to be included in the study should be described. [...] Learning about the literature and how it was obtained, including the keywords and databases used, is of particular interest to readers" (Torraco, 2005, p. 360). In this section the sample for selecting ISDSR articles is described and the three-step research process applied is outlined.

As a search basis, the author used the six top IS journals as defined by the Association for Information Systems (2011), comprising EJIS, ISJ, ISR, JAIS, JMIS, and MISQ.[2] Only full research articles were included that had been reviewed in a double-blind review process. Particularly, the author did not consider opinion papers, editor's comments or introductions to special issues. Moreover, the analysis was restricted to recent articles; only contributions that appeared in the four year-period of 2007-2010 were considered. For assuring comparability between the journals selected, articles that have only been pre-published online were not included.

Step 1: In order to identify candidates of potential ISDSR articles, the author conducted a keyword search in an electronic database. For determining the keywords for this search, he reviewed important articles and books on ISDSR in order to find current signifiers for ISDSR. This review revealed five relevant signifiers: "design research" (e.g.; Vaishnavi & Kuechler, 2004; Winter, 2008), "design science" (e.g.; March & Smith, 1995; Hevner et al., 2004), "design science research" (e.g.; Peffers et al., 2007; Hevner & Chatterjee, 2010), "design theory" (e.g.; Walls et al., 1992; Markus et al., 2002; Gregor & Jones, 2007), and "science of design" (e.g.; Simon, 1984; Simon, 1996). Due to the careful selection of the search strings, the author is confident that the five keywords identified allow for determining (almost) all research that refers to ISDSR. Tests with further search strings (for instance, "theory for design and action", or just "theory for design", as used by Gregor (2006)) showed that no further relevant literature was added to the set of search results. From the database search results, all obviously wrong search results were sorted out, including duplicates, articles that did not appear in one of the six top journals targeted and articles that were not published in an issue in the targeted period of time. Finally, all articles that were not peer-reviewed full research articles were filtered out. The search resulted in 99 candidate articles for consideration. These results are shown in Table 1.

Step 2: The criteria upon which the author decided whether or not an article was ISDSR were developed iteratively in three steps. Firstly, the author worked out criteria based upon literature. Secondly, the author applied these criteria to randomly selected articles taken from the 99 candidates that had resulted from step 1. The aim of this step was to pre-test the applicability of the classification criteria and to refine them. The author stopped this pre-test when it was observed that the refinement of the criteria had reached an acceptable quality – this was after around one third of the whole candidates had been classified. Thirdly, all literature was assessed using the final, refined criteria, including a reassessment of the articles reviewed in the pre-test phase. The finally resulting criteria are described in section 4. In order to identify ISDSR contributions among the 99 candidates, the author looked at each article in detail.

Step 3: The citation analysis conducted thereafter is based on the excellent conceptual foundation by de Mey (1982). Citation and co-citation analyses are also relatively popular in IS research (Culnan, 1986; Eom, 1996; Walstrom & Leonard, 2000; Grover et al., 2006; Loebbecke et al., 2007; Whitley & Galliers, 2007; Clarke, 2008; Moody et al., 2010). The research approach applied in this contribution is similar to that of most of these other citation analyses. The citations of the articles that had resulted from step 3 were extracted; the data quality was manually improved; and then similar citations were

[2] EJIS: European Journal of Information Systems, ISJ: Information Systems Journal, ISR: Information Systems Research, JAIS: Journal of the Association for Information Systems, JMIS: Journal of Management Information Systems, MISQ: Management Information Systems Quarterly

collated. Citations of different editions of the same book were considered as the same citation (cf. also the approach by Moody et al., 2010). The result is presented and discussed in section 5.

Journal	Google Scholar	Manual Correction	Full Research
European Journal of Information Systems (EJIS)	30	30	22
Information Systems Journal (ISJ)	15	14	12
Information Systems Research (ISR)	27[3]	13	7
Journal of the Association for Information Systems (JAIS)	34	33	27
Journal of Management Information Systems (JMIS)	15	15	12
Management Information Systems Quarterly (MISQ)	33	31	19
Sum	154	136	99

Table 1. Search Results per Top IS Journal (Last Verified on 10 March, 2011)

4 FOUNDATIONS: CRITERIA FOR DELINEATING ISDSR FROM OTHER TYPES OF IS RESEARCH

Before the research result is shown, the criteria for delineating ISDSR from other types of IS research are developed. These criteria were applied in step 2 of the research process described previously. Before presenting the criteria, the author would however like to remark that the development of *justifiable* criteria for delineating ISDSR from other types of IS research is a challenge. Although some important articles develop a list of characteristics of design theories (see e.g., Walls et al., 1992) or guidelines for conducting ISDSR (see e.g., Hevner et al., 2004), such recommendations describe ideal ISDSR. They seem to have a strong didactical intention, aiming to help researchers properly conducting ISDSR. Not every published article adhering to the ISDSR paradigm follows all of these recommendations to the full extent. Moreover, not all of the criteria listed by the authors are supported by a consensus in the literature. For the purposes of this paper, the author needs minimal criteria for ISDSR articles. Such minimal criteria have hardly been discussed in literature and need to be developed in this paper. The author mainly ignored candidates of criteria that aim to differentiate good ISDSR from bad ISDSR, including criteria concerning a good research process (e.g., a rigorous evaluation as claimed by Hevner et al. (2004, guideline 3)) or a good justification of the research result (e.g., obligatory kernel theories as claimed by Walls et al. (1992, p. 41)), that is all ISDSR articles in the selected journal issues were analysed. In the following, the finally developed criteria are described. Some of these criteria are highly redundant. This redundancy is deliberately accepted by the author as it allows for reflecting similar aspects from different points of view.

(1) Utility and Problem: An ISDSR artefact is useful as it solves a relevant problem. All authors analysed agree with this (e.g.; Goldkuhl, 2004; Vaishnavi & Kuechler, 2004; Gregor, 2006; Venable, 2006; Gregor & Jones, 2007; Kuechler & Vaishnavi, 2008; Baskerville et al., 2009); we did not find any contribution denying this. When classifying articles, the author checked whether a problem is formulated, whether the author stated that this problem is relevant, and that the research result is meant to solve that problem.

(2) Theory type: Design science research develops theories for design and action rather than descriptive, explanatory, or predictive theories (cf. the five theory types by Gregor, 2006). Many of the seminal contributions to ISDSR differentiate ISDSR to other types of IS research. March and Smith (1995) as well as Hevner et al. (2004) draw upon a distinction between design science and behavioural science. Walls et al. (1992) oppose prescriptive 'how-to' theories (called design theories)

[3] The search for the string „Information Systems Research" as journal title resulted in search results including articles from other journals containing this search string in their title; for instance, „Scandinavian Information Systems Research", or „Advances in Information Systems Research, Education and Practice." This explains the remarkably high difference for ISR between the number of the Google Scholar search results and that of the manual correction.

to descriptive theories. The presciptiveness of DSR is underpinned by Simon's (1996) work, and most authors accept that the output of ISDSR is prescriptive (e.g.; Goldkuhl, 2004; Gregor, 2006; Baskerville et al., 2009; Gregor, 2009); a notable exception is Venable (2006). Gregor (2006) refines the binary categorisation by Walls et al. (1992) and discerns five types of IS theories: theories for analysing; theories for explaining; theories for predicting; theories for explaining and predicting; and theories for design and action. Her refined theory types are very useful for delineating ISDSR from other types of theories, however they are not undisputed. Venable states that "a design theory should be a predictive theory" (Venable, 2006, p. 12) and Baskerville et al. (2010) stress that a design theory can also have explanatory character. We however use Gregor's (2006) refinement, stressing that an ISDSR output should be *mainly* prescriptive rather than *mainly* being descriptive, explanatory, or predictive. This criterion is partly redundant to the first one.

(3) Artefact types or theory components: ISDSR develops constructs, models, methods, or instantiations (March and Smith, 1995). March and Smith (1995) propose an artefact typology that has been adopted by several authors (e.g.; Hevner et al., 2004; Peffers et al., 2007). This typology differentiates between constructs, methods, models, and instantiations. However, literature on ISDT proposes a different conception of ISDSR output – an ISDT seems to encompass models, methods, and constructs (Walls et al., 1992; Gregor & Jones, 2007).[4] As we aim to develop minimal criteria for detecting ISDSR, we stick to the artefact view established by March and Smith. This artefact view is refined by Offermann et al. (2010b): for the purposes of this paper, however, their classification would unnecessarily increase the complexity of the author's research.

A special challenge is to delineate ISDSR from related research approaches, particularly from action research (AR) (for foundations of AR; see e.g.; Checkland & Holwell, 1998; Avison et al., 1999; Davison et al., 2004). The relationship between DSR and AR in IS is disputed. Cole et al. (2005, p. 325) see "interesting parallels and similarities between the two" and Øgland (2009, p. 171) holds the position that AR and DSR are "more similar than dissimilar", whilst Iivary and Venable (2009, p. 1) argue that both are only "[s]eemingly similar but decisively dissimilar." However, in the pre-test conducted with the criteria defined above, the author found that these criteria were suitable for differentiating AR papers that mainly aim to explain or predict phenomena from papers that develop a useful solution to a relevant problem and thereby (partly) refer to AR.

5 FINDINGS

5.1 ISDSR publications in top IS journals

Among the 99 identified candidates, 50 articles are considered as ISDSR according to the criteria defined in the previous section. The distribution of the articles to the journals and some analyses are shown in Table 2. In addition to a differentiation between the years of appearance, the table indicates how many articles have been published in special issues on DSR.[5] The author moreover differentiates between conceptual articles and ISDSR application articles (for this differentiation, see also Indulska and Recker, 2010). ISDSR conceptual papers reflect on the research process (e.g.; Peffers et al., 2006; Kuechler & Vaishnavi, 2008) or the research outcome (e.g.; Gregor & Jones, 2007) whilst ISDSR application papers factually develop a solution to a relevant problem (e.g.; Montero et al., 2007;

[4] Gregor and Jones write: "'[C]onstructs, models and methods' are all one type of thing and can be equated to theory or components of theory" (Gregor & Jones, 2007, p. 320). They identify "principles of form and function" as part of an ISDT; these seem to be similar to models (form) and methods (function). Moreover, constructs are part of their notion of ISDT. Walls et al. (1992) differentiate between a design process (which is dynamic, that is similar to a method) and a design product (which is static, that is similar to a model).

[5] Only articles of the tpye ISDSR application are considered in this class.

Abbasi, 2010). Furthermore, the author discerns macro DSR from micro DSR.[6] Macro DSR develops a huge artefact or design theory (e.g.; Kolfschoten & De Vreede, 2009; Chou et al., 2010) whilst micro DSR is mainly useful for justifying one (or few) single design decisions (e.g.; Nadkarni, 2007; Keith et al., 2009; Blanco et al., 2010). A differentiation between ISDSR conceptual papers and ISDSR application papers as well as between macro-research and micro-research is not always clear, and as this classification is however not the main aim of this paper, the author only roughly categorises the articles in order to give some orientation to the reader.

Table 2 shows that around one half of the candidates fulfilled the pre-defined criteria for ISDSR. One sixth of the identified ISDSR application articles can be considered as micro-research. However, some scholars in the field of ISDSR would certainly doubt that these articles constitute ISDSR. The distribution of ISDSR articles over years is relatively constant.[7] This allows for the interpretation that ISDSR has a persistent standing in the IS research community, although the relative number of ISDSR articles compared to main research streams in IS research is still small. A special outlet for ISDSR articles seems to be JAIS; nearly 40% of all ISDSR articles appear in this journal. In half of the journals (JAIS, EJIS, and MISQ), more than three quarters of ISDSR articles are published. Moreover, a high number of ISDSR articles appear in a special issue relating to ISDSR. JAIS is obviously the only journal that has accepted a large number of ISDSR articles in its regular issues. Putting ISDSR articles in JAIS to one side for a moment, nearly half of all ISDSR articles (10 out of 21) appear in a special issue of the other publications. This observation supports the author's assumption that ISDSR is still establishing itself. More than one quarter of the ISDSR articles are conceptual articles. This supports the author's assumption that ISDSR is still in a pre-paradigmatic phase as intensive discussion on its theoretical basis is still being conducted. Further analysis however shows that the absolute number of conceptual articles very slightly decreases over time (2007: 6, 55%; 2008: 5, 31%; 2009: 3, 33%; 2010: 4, 27%), which allows the interpretation that ISDSR *is* maturing but slowly.

Journal	DSR Articles	Year				Special Issue on DSR		Conceptual/ Application		Granularity[6]	
		2007	2008	2009	2010	Yes	No	Appl.	Conc.	Macro	Micro
EJIS	10	1	6	0	3	5	5	9	1	8	1
ISJ	4	2	0	1	1	0	4	1	3	1	0
ISR	4	2	1	0	1	0	4	4	0	2	2
JAIS	20	3	4	7	6	4[5]	16	17	3	16	1
JMIS	3	1	0	1	1	0	3	1	2	1	0
MISQ	9	2	5	0	2	5	4	8	1	7	1
Sum	50	11	16	9	14	14	36	40	10	35	5

Table 2. ISDSR Articles in Top IS Journals

5.2 ISDSR Body of Knowledge

A further criterion for evaluating the maturity of ISDSR is the emergence of a common body of knowledge. The citation analysis conducted identified 221 sources that have been cited by at least two papers; among them 148 sources cited by exactly two papers, and 48 sources cited by three papers. The 25 sources cited by four or more papers are listed in Table 3.

[6] JAIS published a special issue on "Collaboration Engineering" (Vol. 10, Is. 9, 2009); the editors define collaboration engineering as "as an approach to *designing* collaborative work practices" (Vreede et al., 2009, p. 119, emphasis added). As exclusively *DSR* on collaboration was called for, we considered this special issue as an ISDSR special issue.

[7] The higher number of articles in 2008 is certainly also due to two special issues that appeared in this year (EJIS, Vol. 17, Is. 5, 2008; and MISQ, Vol. 32, Is. 4, 2008); the JAIS special issue on collaboration engineering (Vol. 10, Is. 9, 2009) however does not significantly increase the total number of ISDSR articles.

No.	Pl.	Author(s)	Year	Title	Cit.	%
[1]	1	Hevner et al.	2004	Design Science in Information Systems Research	35	70%
[2]	2	Walls et al.	1992	Building an Information System Design Theory for Vigilant EIS	14	28%
[3]	3	Simon	1981/ 1996	The Sciences of the Artificial	13	26%
[4]	4	March & Smith	1995	Design and Natural Science Research on Information Technology	12	24%
[5]	5	Markus et al.	2002	A Design Theory for Systems that Support Emergent Knowledge Processes	10	20%
[6]	6	Gregor & Jones	2007	The Anatomy of a Design Theory	7	14%
[7]	6	Walls et al.	2004	Assessing Information Design Theory in Perspective: How Useful was our 1992 Initial Rendition	7	14%
[8]	8	Berners-Lee et al.	2001	The Semantic Web	5	10%
[9]	8	DeSanctis & Poole	1994	Capturing the Complexity in Advanced Technology Use: Adaptive Structuration Theory	5	10%
[10]	8	Gamma et al.	1995	Design Patterns: Elements of Reusable Object-Oriented Software	5	10%
[11]	8	Orlikowski & Iacono	2001	Research Commentary: Desperately Seeking It in IT Research – A Call to Theorizing the IT Artifact	5	10%
[12]	12	Alexander	1979	The Timeless Way of Building	4	8%
[13]	12	Baskerville & Wood-Harper	1998	Diversity in Information Systems Action Research Methods	4	8%
[14]	12	Briggs et al.	2003	Collaboration Engineering with ThinkLets to Pursue Sustained Success with Group Support Systems	4	8%
[15]	12	Davis	1989	Perceived Usefulness, Perceived Ease of Use and User Acceptance of Information Technology	4	8%
[16]	12	Eisenhardt	1989	Building Theories from Case Study Research	4	8%
[17]	12	Goldkuhl	2004	Design Theories in Information Systems – A Need for Multi-Grounding	4	8%
[18]	12	Gregor	2006	The Nature of Theory in Information Systems	4	8%
[19]	12	Hirschheim	1995	Information Systems Development and Data Modeling	4	8%
[20]	12	Klein & Myers	1999	A Set of Principles for Conducting and Evaluating Interpretive Field Studies in Information Systems	4	8%
[21]	12	Lau	1997	A Review of Action Research in Information Systems Studies	4	8%
[22]	12	Miles & Huberman	1994	Qualitative Data Analysis	4	8%
[23]	12	Sowa	2000	Knowledge Representation: Logical, Philosophical, and Computational Foundations	4	8%
[24]	12	Vaishnavi & Kuechler	2004	Design Research in Information Systems	4	8%
[25]	12	Winograd & Flores	1986	Understanding Computers and Cognition: A New Foundation for Design	4	8%

Table 3. Most Cited Sources in ISDSR Top-Journal Articles

Table 3 reveals that the most cited source in ISDSR is the contribution by Hevner et al. [1][8]; it is quoted by 2.5 times more articles than the second most cited contribution by Walls et al. [2]. As 70% of all ISDSR articles cite Hevner et al [1], this article can be considered as *the* main foundation of ISDSR. Among the seven articles cited by more than 10% of all authors, there are four journal articles on ISDT [2; 5; 6; 7], two journal articles by authors holding the artefact view [1; 4] and one book by

[8] The numbers in brackets indicate the consecutive number of the articles listed in Table 3. Due to space restrictions, not all of these articles appear in the reference list of this paper.

the Nobel laureate in economics and Turing Award laureate Herbert Simon [3]. However, among these top seven sources, articles with the artefact view have been cited 47 times in sum whilst articles with the design theory view have only been cited 28 times in sum. Remarkable is also that the article by Gregor and Jones [6] is the only publication of Table 3 that appeared during the period of enquiry and it is among the top seven cited articles.

Nevertheless, the ISDSR body of knowledge identified only rarely includes knowledge on ISDSR application. Among the seven most cited papers, only two papers *mainly* describe the application of ISDSR [2; 5], however, a closer look at the papers that cite these sources reveals that nearly all of them refer to the conceptual contribution of these papers rather than to the developed solution. Among all sources listed in Table 3, only 5 publications [8; 9; 14; 15; 19], that is 20%, are considered to have a strong component of ISDSR application. In ISR, this value is 60 % percent (Moody et al., 2010, table 3). Three of the ISDSR application citations mainly contain descriptive knowledge [8; 9; 15] while two of them mainly contain normative knowledge [14; 19]. The fact that ISDSR has obviously hardly established a common basis for ISDSR on the level of ISDSR application contributions is certainly an indicator that ISDSR is still maturing. The conceptual ISDSR literature from Table 3 is on design [1; 2; 3; 4; 5; 6; 7; 17; 18; 24; 25], qualitative research including interpretative research [16: 20; 21; 22], action research [13; 21], patterns [10; 12], knowledge representation [23] and the role of the IT artefact in IS articles [11].

6 CONCLUSION

The contribution of this paper is threefold. Firstly, three (partly redundant) criteria for discerning ISDSR from other types of research are developed. These criteria are in turn, that the research contribution solves a problem and is useful, that the research contribution is normative ("how-to") and not descriptive, and that the structure of the research output corresponds to one of the four artefact types defined by March and Smith (1995) or to the structure of an ISDT (Walls et al., 1992; Gregor & Jones, 2007). The secondary contribution of the paper is the identification of 50 ISDSR articles published in the six top IS journals from 2007-2010. The third aspect of the paper is that the ISDSR body of knowledge is systematically developed based upon a citation analysis. The result of this is that *the* common foundation of ISDSR seems to be the publication by Hevner et al. (2004), having been cited by 70% of all articles analysed. Moreover, the publications by Walls et al. (1992; 2004), Simon (1984; 1996), March and Smith (1995), Markus et al. (2002) and Gregor and Jones (2007) are highly influential to the field. (For a complete overview of the most cited references, see Table 3.)

All these three contributions are new; the author is not aware of any similar previous publication Compared to other recent surveys on ISDSR literature (e.g.; Indulska & Recker, 2010), the research approach of this paper is well documented so that other IS researchers should be able to replicate it. As far as the ISDSR body of knowledge is concerned, the author's approach fundamentally differs from that by Vaishnavi and Kuechler (2004), who propose a literature list mainly based upon their expert judgement. Moreover, the findings of this research provide deep insights into the structure of the ISDSR body of knowledge. The analysis shows that ISDSR does have a common body of knowledge and a cumulative tradition. The findings also show that ISDSR is well anchored in the IS research tradition. However, the common foundation of ISDSR is mainly composed of ISDSR conceptual papers rather than of ISDSR application papers. The author postulates that the addition of ISDSR application research to the ISDSR body of knowledge, including descriptive and normative knowledge will be one of the important challenges of ISDSR of the next years.

As a limitation of the articles, it could be posited that there is a logical shortcoming in the method used by the author: circularity. One could argue that the criteria for selecting the ISDSR articles whose citations are interpreted as the ISDSR body of knowledge are extracted from the very same publications that result from the analysis. Although this argument is true, this issue is common to all citation analyses to a particular research field. An alternative approach would have been not to analyse the top IS journal articles, but, for instance, articles published in special issues on ISDSR, presented at conferences dedicated to ISDSR (e.g., the DESRIST conferences) or at conference tracks focusing on ISDSR. However, the problem would be very similar as editors, conference chairs, track

chairs, and reviewers would probably also decide upon criteria defined in seminal ISDSR articles whether or not a submission is ISDSR. As a second limitation, the author restricted to top IS journals. These journals do not focus a specific IS research area. The author argues that an analysis of ISDSR articles of journals like Decision Support Systems might give further insights, in which Arnott and Pervan (2007) find some earlier ISDSR contributions. The author supposes that more ISDSR application contributions are cited in such journals; however, this needs to be proven in further research. A third limitation of the research conducted is that citations are only counted, but that their role in the paper and their influence on the research process and outcome are not considered. The author acknowledges that a content analysis of the importance of the respective citations may provide further insights. However, this should be done in further research. Moreover, most of the other citation analyses cited above only perform a quantitative analysis.

Space limitations for this conference paper did not allow to completely analysing the data collected. In further publications, the author would like to provide a deeper analysis. The author specifically intends on focussing a research question on whether or not sub-paradigms exist in ISDSR. One hypothesis for two sub-paradigms could be that a design theory view and an artefact view exist. The existence of sub-paradigms in ISDSR would support the assumption that ISDSR is far away from entering into the state of normal science. If sub-paradigms exist, two paths for a further development are imaginable: Either these sub-paradigms harmonise to one ISDSR paradigm or they develop independently. A co-citation analysis, a cluster analysis and statistical tests can be conducted for investigating whether or not sub-paradigms exist. The author would like to anticipate that the results of a first cluster analysis conducted give no cause for concern and that independently developing sub-paradigms cannot be identified. In further publications, this point should be further developed.

References

Abbasi, A. (2010). Detecting Fake Websites: The Contribution of Statistical Learning Theory. MIS Quarterly 34 (3), 435-461.

Aier, S. and Fischer, C. (2011). Criteria of Progress for Information Systems Design Theories. Information Systems and E-Business Management 9 (1), 133-172.

Arnott, D. and Pervan, G. (2007). The Methodological and Theoretical Foundations of Decision Support Systems Research. Information Systems Foundations: Theory, Representation and Reality. (Hart, D. N. and Gregor, S. D., Eds), The Australian National University E Press, Canberra.

Association for Information Systems (2011). Senior Scholars' Basket of Journals, http://home.aisnet.org/displaycommon.cfm?an=1&subarticlenbr=346, last accessed 2011-03-09.

Avison, D. E., Lau, F., Myers, M. D. and Nielsen, P. A. (1999). Action Research. *Communications of the ACM* 42 (1), 94-97.

Baskerville, R. and Pries-Heje, J. (2010). Explanatory Design Theory. Business & Information Systems Engineering 2 (5), 271-282.

Baskerville, R. L., Pries-Heje, J. and Venable, J. (2009). Soft Design Science Methodology. In Proceedings of the 4th International Conference on Design Science Research in Information Systems and Technology (DESRIST 2009), New York, 1-11.

Blanco, C. F., Sarasa, R. G. and Sanclemente, C. O. (2010). Effects of Visual and Textual Information in Online Product Presentations: Looking for the Best Combination in Website Design. European Journal of Information Systems 19 (6), 668-686.

Checkland, P. and Holwell, S. (1998). Action Research: Its Nature and Validity. *Systemic Practice and Action Research* 11 (1), 9-21.

Chou, C. H., Sinha, A. P. and Zhao, H. (2010). A Hybrid Attribute Selection Approach for Text Classification. Journal of the Association for Information Systems 11 (9), 491-518.

Clarke, R. (2008). A Citation Analysis of Australian Information Systems Researchers: Towards a New ERA? Australasian Journal of Information Systems 15 (2), 23-44.

Cole, R., Purao, S., Rossi, M. and Sein, M. K. (2005). Being Proactive: Where Action Research Meets Design Research. In Proceedings of the International Conference on Information Systems (ICIS 2005), 325-336.

Culnan, M. J. (1986). The Intellectual Development of Management Information Systems, 1972-1982: A Co-Citation Analysis. Management Science 32 (2), 156-172.
Davison, R. M., Martinsons, M. G. and Kock, N. (2004). Principles of Canonical Action Research. Information Systems Journal 14 (1), 65-86.
De Mey, M. (1982). The Cognitive Paradigm. Cognitive Science. A Newly Explored Approach to the Study of Cognition Applied in an Analysis of Science and Scientific Knowledge. Reidel Publishing, Dordrecht.
Eom, S. B. (1996). Mapping the Intellectual Structure of Research in Decision Support Systems through Author Cocitation Analysis (1971-1993). Decision Support Systems 16 (4), 315-338.
Fischer, C., Winter, R. and Wortmann, F. (2010). Design Theory. Business & Information Systems Engineering 2 (6), 387-390.
Goldkuhl, G. (2004). Design Theories in Information Systems – A Need for Multi-Grounding. Journal of Information Technology Theory and Application 6 (2), 59-72.
Gregor, S. (2006). The Nature of Theory in Information Systems. MIS Quarterly 30 (3), 611-642.
Gregor, S. (2009). Building Theory in the Sciences of the Artificial. In Proceedings of the Proceedings of the 4th International Conference on Design Science Research in Information Systems and Technology (DESRIST 2009), New York.
Gregor, S. and Jones, D. (2007). The Anatomy of a Design Theory. Journal of the Association for Information Systems 8 (5), 312-335.
Grover, V., Ayyagari, R., Gokhale, R., Lim, J. and Coffey, J. (2006). A Citation Analysis of the Evolution and State of Information Systems within a Constellation of Reference. Journal of the Association for Information Systems 7 (5), 270-325.
Hevner, A. R. and Chatterjee, S. (2010). Design Research in Information Systems: Theory and Practice. Springer, Dordrecht.
Hevner, A. R., March, S. T., Park, J. and Ram, S. (2004). Design Science in Information Systems Research. MIS Quarterly 28 (1), 75-105.
Iivari, J. and Venable, J. (2009). Action Research and Design Science Research – Seemingly similar but decisively dissimilar. In Proceedings of the 17th European Conference on Information Systems (ECIS 2009), Verona, Italy.
Indulska, M. and Recker, J. (2010). Design Science in IS Research: A Literature Analysis. Information Systems Foundations: The Role of Design Science Workshop (Hart, D. N. and Gregor, S. D., Eds), The Australian National University E Press, Canberra.
Keith, M., Shao, B. and Steinbart, P. (2009). A Behavioral Analysis of Passphrase Design and Effectiveness. Journal of the Association for Information Systems 10 (2), 63-89.
Kolfschoten, G. L. and De Vreede, G. J. (2009). A Design Approach for Collaboration Processes: A Multimethod Design Science Study in Collaboration Engineering. Journal of Management Information Systems 26 (1), 225-256.
Kuechler, B. and Vaishnavi, V. K. (2008). On Theory Development in Design Science Research: Anatomy of a Research Project. European Journal of Information Systems 17 (5), 489-504.
Kuechler, W., Vaishnavi, V. K. and Kuechler Sr, W. L. (2007). Design [Science] Research in IS – A Work in Progress. In Proceedings of the Second International Conference on Design Science Research in Information Systems and Technology (DESRIST 2007), 1-17.
Kuhn, T. S. (1970). The Structure of Scientific Revolutions. 3. Chicago University Press, Chicago.
Loebbecke, C., Berthod, O. and Huyskens, C. (2007). Research Importance in the Information Systems Field: A Citation Analysis. In Proceedings of the 28th International Conference of Information Systems, 9-12.
March, S. T. and Smith, G. F. (1995). Design and Natural Science Research on Information Technology. Decision Support Systems 15 (4), 251-266.
Markus, M. L., Majchrzak, A. and Gasser, L. (2002). A Design Theory for Systems that Support Emergent Knowledge Processes. MIS Quarterly 26 (3), 179-212.
Montero, S., Díaz, P. and Aedo, I. (2007). From Requirements to Implementations: A Model-Driven Approach for Web Development. European Journal of Information Systems 16 (4), 407-419.
Moody, D., Iacob, M.-E. and Amrit, C. (2010). In Search of Paradigms: Identifying the Theoretical Foundations of the IS Field. In Proceedings of the 18th European Conference on Information Systems, Pretoria, South Africa.

Nadkarni, S. (2007). A Task-Based Model of Percieved Website Complexity. MIS Quarterly 31 (3), 501-524.
Nunamaker, J. F., Chen, M. and Purdin, T. D. M. (1991). Systems Development in Information Systems Research. Journal of Management Information Systems 7 (3), 89-106.
Offermann, P., Blom, S., Levina, O. and Bub, U. (2010a). Proposal for Components of Method Design Theories. Business & Information Systems Engineering 2 (5), 295-304.
Offermann, P., Blom, S., Schönherr, M. and Bub, U. (2010b). Artifact Types in Information Systems Design Science – A Literature Review. In Proceedings of the 5th International Conference on Design Science Research in Information Systems and Technology (DESRIST 2010), Berlin.
Øgland, P. (2009). Action Research and Design Science Research – More similar than dissimilar. In Proceedings for Norsk konferanse for organisasjoners bruk av informasjonsteknologi, NOKOBIT 16, Trondheim, Norway, 171-184.
Peffers, K., Tuunanen, T., Gengler, C. E., Rossi, M., Hui, W., Virtanen, V. and Bragge, J. (2006). The Design Science Research Process: A Model for Producing and Presenting Information Systems Research. In Proceedings of the First International Conference on Design Science Research in Information Systems and Technology (DESRIST 2006) (Chatterjee, S. and Hevner, A., Eds), 83-106.
Peffers, K., Tuunanen, T., Rothenberger, M. A. and Chatterjee, S. (2007). A Design Science Research Methodology for Information Systems Research. Journal of Management Information Systems 24 (3), 45-77.
Simon, H. A. (1984) The Sciences of the Artificial. 2. MIT Press, Cambridge, MA.
Simon, H. A. (1996) The Sciences of the Artificial. 3. MIT Press, Cambridge, London.
Torraco, R. J. (2005). Writing Integrative Literature Reviews: Guidelines and Examples. Human Resource Development Review 4 (3), 356-356.
Vaishnavi, V. and Kuechler, W. (2004). Design Research in Information Systems, http://ais.affiniscape.com/displaycommon.cfm?an=1&subarticlenbr=279, last updated 2009-08-16, last accessed 2011-02-08.
Vaishnavi, V. K. and Kuechler, W. (2007). Design Science Research Methods and Patterns: Innovating Information and Communication Technology. Auerbach Publications, New York, NY.
Venable, J. (2006). The Role of Theory and Theorising in Design Science Research. In Proceedings of the First International Conference on Design Science in Information Systems and Technology (DESRIST 2006) (Chatterjee, S. and Hevner, A., Eds), 1-18, Claremont Graduate University, Claremont.
Vom Brocke, J., Simons, A., Niehaves, B. R., Riemer, K., Plattfaut, R. and Cleven, A. (2009). Reconstructing the Giant: On the Importance of Rigour in Documenting the Literature Search Process. In Proceedings of the17th European Conference on Information Systems (ECIS 2009) (Newell, S. and Whitley, E. and Pouloudi, N. and Wareham, J. and Mathiassen, L., Eds), 2206-2217.
Vreede, G. J. D., Massey, A. and Briggs, R. (2009). Introduction to JAIS Special Issue on Collaboration Engineering. Journal of the Association for Information Systems 10 (3), 118-120.
Walls, J. G., Widmeyer, G. R. and El Sawy, O. A. (1992). Building an Information System Design Theory for Vigilant EIS. Information Systems Research 3 (1), 36-59.
Walls, J. G., Widmeyer, G. R. and El Sawy, O. A. (2004). Assessing Information Systems Design Theory in Perspective: How Useful was our 1992 Initial Rendition? Journal of Information Technology Theory and Application 6 (2), 43-58.
Walstrom, K. A. and Leonard, L. N. K. (2000). Citation Classics from the Information Systems Literature. Information & Management 38 (2), 59-72.
Whitley, E. A. and Galliers, R. D. (2007). An Alternative Perspective on Citation Classics: Evidence from the First 10 Years of the European Conference on Information Systems. Information & Management 44 (5), 441-455.
Winter, R. (2008). Design Science Research in Europe. European Journal of Information Systems 17, 470-475.